

Recommendation from SAC 2009 Ship Strike Report	Progress Made	Status/Gaps/Work Remaining	Next Steps	Comments from SeaSketch and Webinar (9/21/15)	Links and Literature
1. Improve monitoring efforts to track whale distribution spatially and temporally within sanctuary, within and in close proximity to shipping lanes (i.e. acoustic, aerial and photographic monitoring)	Acoustic Monitoring: Scripps deployed 4 HARPS (bottom-mounted passive acoustic data recorders called high-frequency Acoustic Recording Packages, or HARPS) in 2009; continued HARP monitoring from 2009-2012. NMFS deployed a passive hydrophone on the south side of Santa Cruz Island in 2014. CINMS and NMFS sought 2015 grant funds to deploy 2 MicroMARS hydrophones, grant was not awarded.	2 HARPS removed, 2 remain at either end of the SB Channel. Need a long-term funding source and dedicated personnel to process and report on data; currently funded via Navy grant to Scripps Institute of Oceanography in the Hildebrand lab.	Understand the utility of acoustic monitoring data for long-term whale habitat characterization vs. real-time monitoring/ more near real time management	Need to determine what type of whale sightings data is most valuable/useful for management. With regard to acoustic monitoring, Oleson et al. (2007) states, "Our results show that visual and acoustic detection rates differ seasonally and geographically within the Southern California Bight. These differences suggest that a single detection mode may be insufficient to detect blue whales in all seasons and regions. Behavior and calling are linked, such that production of certain call types may be correlated with specific behaviors (such as long dive duration) that make whales difficult to detect visually. Conversely, these behaviors may not be tied to whale density such that acoustic detection alone may not provide a reliable estimate of abundance, particularly in regions with large aggregations of blue whales."	<a href="#">Stevic et al. 2015: Seven years of blue and fin whale call abundance in the SBC</a> , <a href="#">Oleson et al. 2007: Blue whale visual and acoustic encounter rates in the Southern California Bight</a>
	Aerial Monitoring: Aerial flight surveys conducted by NOAA within CINMS from 1999-2011; Partnership with NMFS expanded the geographic range of surveys to include the south side (back side) of the islands in 2011-2012 only; Starting in 2013 with PMSA funding, CINMS conducts seasonal monthly aerial surveys on charter aircraft of the shipping lanes.	The number of aerial surveys was reduced in 2010 due to budget and NOAA aircraft being relocated out of the region. Aerial surveys conducted in 2011-12 south of the islands discontinued due to funding. Current funding may last through 2016 whale season for shipping lane flights only. Need to deepen the pool of flight trained observers. Dedicate smart device with Spotter Pro to streamline recording sightings.	Secure funding stream - minimum \$10k for 1 flight/month for shipping lanes only in SB Channel.		
	Photographic Monitoring: Channel Islands Naturalist Corps records whale sightings data year round and provides photo ID data to John Calambokidis, Cascadia Research, who also carries out photo ID monitoring during research cruises.	It is expected that the Naturalist Corps photographic monitoring will continue into the future.	Expand photo ID work to non-sanctuary areas would require substantial volunteer training and maintenance.		
	Opportunistic Sightings - Citizen Science (CINC): Channel Islands Naturalist Corps volunteers record opportunistic whale sightings while aboard commercial whale watching vessels out of the Santa Barbara, Ventura, and Channel Islands harbors. Volunteers use either the Spotter Pro mobile application or paper forms to record the date, time, species, geographic coordinates, number of individuals, distance between the vessel and the animal, behavior and which vessel they are aboard at the during the sighting. This is opportunistic sighting data that have not been effort corrected.	Long time series (15 years) with many data points, but spatial coverage is greatly limited. Observations are concentrated near the Santa Barbara and Ventura harbors, where most of the whale watching vessels depart. Data gaps exist for the western SB channel and back side of the islands. Began collecting effort data in 2013 when naturalists started using Spotter Pro (a mobile app) to record sightings.	Identify additional user groups to start using Spotter Pro or Whale Alert, including: CDFW, fishing industry, offshore oil rig service vessels, shipping industry, dive boats, researchers, etc.		
	Opportunistic Sightings - Citizen Science (Whale Alert): Whale Alert is a mobile app that the public can use to record whale sightings.	Adoption rate is relatively low - <10,000, media effort	Consider how to incentivize use of Whale Alert among multiple user groups. Evaluate which user groups should be trained for Spotter Pro, and which should use Whale Alert.		<a href="#">Large Cetacean Analysis for the SBC Region (2011)</a>
2. Improve understanding of life history, biology and behavior of large whales in SBC	CINMS staff and Cascadia Research completed a report characterizing cetacean sightings in and around SBC shipping lanes. Results demonstrated that seasonally there was close association between blue, fin and humpback whales with portion of the shelf break (200 meter isobaths). The report also identified hot-spots for specific species including humpback, fin, and blue whales. The report demonstrated that certain areas have greater probabilities for encountering whales.	The report identifies the need to carry out further statistical analysis for determining whale distribution probabilities. It also acknowledges the need for additional staff resources to complete this analysis.			
	John Calambokidis has conducted whale tagging and behavior studies (2009-2012). This research suggests blue whales dive shallower when ships are nearby and that the whales float and drift close to the surface at night.	Tagging data set relatively small. Cascadia Research and its partners continue looking for additional opportunities to conduct more whale behavior research.			<a href="#">McKenna et al. 2015: Simultaneous tracking of blue whales and large ships demonstrates limited behavioral responses for avoiding collision</a>
	Oregon State University Marine Mammal Institute (Bruce Mate and others) have conducted tagging work around the sanctuary.				<a href="#">Irvine et al. 2014: Spatial and Temporal Occurrence of Blue Whales off the West Coast</a>
	Publication in review about noise effects from commercial vessels on whale communication and behavior in the Santa Barbara Channel region (from HARP data). Data suggests in some cases, whales have longer surface intervals after ships pass nearby.	Ocean noise paper with CINMS case study in peer review.			

	<p>NMFS Southwest Region convened a Science Workshop at the NOAA Science Center (May 19-20, 2010) to focus on data needs, determine how to fill data gaps, and identify future work. Action items identified: 1) collate available whale distribution data to develop a model to determine whale densities in the SBC 2) identify methods to determine potential impacts to whale populations (i.e. significance of threat) along the U.S. West Coast 3) identify short and long term data needs 4) convene workshop to collate available shipping data and 5) some workshop participants expressed their intent to send comments to the U.S. Coast Guard on the LA PARS study. In 2014, NMFS convened a workshop where they provided updates on the 2010 recommendations.</p>	<p>1) Working group has not convened, but several whale distribution models exist (see links). More research is needed to refine models. 2) Methods to identify severity of threat have not been agreed upon. Multiple papers analyze the impacts of vessel collisions to whale populations. Bettridge et al. 2015: Vessel collisions were identified as a moderate threat with an increasing trend for the Central America distinct population segment of humpback whales, which feeds in CINMS. Redfern et al. 2013: The estimated number of ship strikes for fin and humpback whales may be sustainable. Even conservative estimates of the number of blue whale ship strikes are higher than the potential biological removal (the max number of animals that may be removed annually by anthropogenic causes while allowing the population to reach or maintain its optimal sustainable population). Monahan et al. 2015: Estimate that density dependence, not ship strikes, is the key reason for observed lack of increase in blue whale populations, and future strikes will likely have a minimal impact on the long-term population. Although they estimated ship strike mitigation would have minimal impacts on population levels and status, current levels of ship strikes are likely above legal limits set by the U.S. Additional analysis is needed for other species. 3) Short and long term data needs are being developed by NMFS. 4) Workshops for sharing shipping data have not yet convened, but the data that would have been gathered via that type of venue has been completed. 5) Some Workshop participants commented on the USCG PARS study.</p>	<p>Highlight the need for models that integrate all existing datasets.</p>	<p><a href="#">Report from 2010 NMFS Workshop: Reducing Vessel Strikes of Large Whales in California</a></p> <p><a href="#">Report from 2014 NMFS Workshop: Large Whale Distribution and Occurrence Workshop Report</a></p> <p><a href="#">Status Review of Humpback Whale</a></p> <p><a href="#">2014 Irvine et al. Spatial and Temporal Occurrence of Blue Whales off the U.S. West Coast</a></p> <p><a href="#">2013 Redfern et al. Assessing the Risk of Ships Striking Large Whales in the Waters of the U.S. West Coast</a></p> <p><a href="#">2015 Calambokidis et al. Biologically Important Areas for Protected Cetaceans Within U.S. Waters – West Coast Region</a></p> <p><a href="#">2015 Monahan et al. Do Ship Strikes Threaten the Recovery of Endangered Eastern North Pacific Blue Whales?</a></p>
3. Monitor annual distribution of krill	<p>Indirect sensing of krill via airplane is possible through chlorophyll concentrations, but predictive capacity is limited.</p>	<p>We are not aware of any efforts to monitor krill for its relationship to whale biology in the SBC Region.</p>	<p>Whales are easier to monitor than krill.</p>	
4. Continue and improve monitoring efforts to track vessels (spatially and temporally) within the Sanctuary, within and in close proximity to shipping lanes	<p>CINMS staff has developed in-house capacity to receive, process, and analyze Automated Identification System (AIS) data that can track vessel traffic within the SBC Region. AIS capacities currently cover the entire Sanctuary, SB Shipping lanes, and south side (back side) of the islands. AIS data was used to analyze vessel compliance during the Vessel Speed Reduction Incentive Trial.</p>	<p>CINMS staff continues to upgrade AIS capabilities. In March 2013, a new automated AIS system was installed at Santa Cruz Island. Access to AIS data west and north of VAFB would fill gaps in coverage, an MOU with VAFB has not moved forward.</p>		
5. Recruit local colleges, universities, and research institutions to assist with research.	<p>In 2010/11 CINMS and NMFS partnered as clients on a UCSB Bren group project titled "Reducing the Risk of Vessel Strikes to Endangered Whales in the Santa Barbara Channel: An Economic Analysis and Risk Assessment of Potential Management Scenarios." This study developed two models. One estimating the change in relative risk of a lethal strike based on predicted whale distributions. A second model calculated change in total cost to the shipping industry across four different management scenarios. Results suggest that mandatory speed reduction has the potential to be the most cost effective management option.</p> <p>In the fall of 2012, a UCSB Bren school cost benefit class examined the costs and benefits of using CA Cap and Trade auction funds to slow down cargo ships within the SBC. Results varied with the majority of groups identifying that over the long term (20+ years) benefits outweighed costs; however, several groups had the opposite findings.</p> <p>In 2015/2016, CINMS, NCCOS, and SBAPCD are partnering as clients on a UCSB Bren group project titled, "Vessel Speed Reduction, Air Pollution, and Whale Strike Tradeoffs in the Santa Barbara Channel Region: Solution-oriented Integration of Health and Ecosystem Service Valuation"</p>	<p>The Bren report identifies the need for further research to refine the whale distribution and relative risk model.</p> <p>Current Bren project wraps up in spring 2016 to provide whale valuation data, NCCOS economic impact analysis expected in Summer 2016.</p>	<p><a href="#">Betz et al. 2011: Reducing the Risk of Vessel Strikes to Endangered Whales in the Santa Barbara Channel: An Economic Analysis and Risk Assessment of Potential Management Scenarios</a></p>	
6. Seek out additional sources of funding for research	<p>Hollings Grant to fund the development of Spotter Pro, a mobile app that will be used by the Naturalist Corps to record whale sightings; NCCOS Ship Strike Whale Award (100K) funding 2015 Bren Project and NCCOS Economic Analysis of MSGW recommendations; Vessel Speed Reduction Trial funding (90K awarded by SB Foundation, SB and Ventura Counties APCDs).</p>	<p>Hollings Grant not awarded. NCCOS \$5 awarded. See note above about additional hydrophones not being funded and funding constraints for aerial monitoring.</p>		<p><a href="#">Vessel Speed Reduction, Air Pollution, and Whale Strike Tradeoffs in the Santa Barbara Channel Region: Solution-oriented Integration of Health and Ecosystem Service Valuation</a></p>
Additional Areas of Research (Identified by Sanctuary Staff and Marine Shipping Working Group)	<p>Progress Made</p>	<p>Status/Gaps/Work Remaining</p>	<p>Next Steps</p>	<p>Links and Literature</p>
Monitor and Assess safety of navigation in the SBC region	<p>In 2011, USCG published a Port Access Route Study to assess whether the creation of, or modification to, a vessel routing system is necessary to improve safety of navigation when approaching LA/LB and transiting the SBC. The report concluded that creating a TSS south of the Channel Islands to accommodate USCG's safety concerns for vessels using the alternate approaches to LA/LB would keep traffic on a predictable course.</p>	<p>Proposed TSS south of the Islands did not move out of the US Delegation to the IMO for consideration. Traffic continues south of the islands. A western voluntary lane was put in place by the Harbor Safety Committee and it is widely utilized.</p>	<p>USCG and NOAA to determine safety of navigation situation south of islands in 2015.</p>	<p><a href="#">2011 USCG: Port Access Route Study (PARS). Approaches to Los Angeles/Long Beach and in the Santa Barbara Channel</a></p>

Analyze the impacts of ship emissions on local air quality in Santa Barbara County and the effectiveness of different management strategies to reduce ship emissions. Expand studies to include all southern California coastal counties.	<p>The Deep Sea Vessel/Shipping Channel Technical Working Group (TWG) conducted a comparative technical analysis of the air quality impacts between two potential operational control strategies for Southern California and reached the following conclusions: 1) Reducing the speed at which ships travel reduces the flux of NOx emissions that reach onshore. The magnitude of the reductions is dependent upon the degree of speed reduction and the distance traveled at the reduced speed with the reductions proportional to the distance traveled and the reduced speed. 2) The impact of moving the shipping lane further offshore on the onshore flux of NOx emissions is more sensitive to meteorological conditions. On some days there is an emission reduction benefit and on other days there is a disbenefit, depending on the specific weather and wind conditions.</p> <p>Port of LA/Port of LB analyze emission reduction benefits from VSR in their 2010 Clean Air Action Plan (starting on p. 108)</p> <p>Santa Barbara County Clean Air Plan (2013) indicates that 57% of nitrogen oxide emissions in Santa Barbara County are from marine shipping.</p>				<p><a href="#">CARB 2000: Air Quality Impacts from NOx Emissions of Two Potential Marine Vessel Control Strategies in the South Coast Air Basin</a></p> <p><a href="#">2010 Port of LA and Port of LB: San Pedro Bay Ports Clean Air Action Plan</a></p> <p><a href="#">2013 Santa Barbara County Clean Air Plan</a></p>
Analyze the impact of vessel speed reduction on ship emissions generally	Multiple publications analyze the impact of VSR on ship emissions, and generally conclude that lowers speeds lead to reductions in air pollution emissions. Khan et al. (2012) states, "VSR to 12 knots yielded carbon dioxide and nitrogen oxides emissions reductions (in kg/nautical mile) of approximately 61% and 56%, respectively, as compared to vessel cruise speed."				<p><a href="#">2012 Khan et al: Greenhouse Gas and Criteria Emission Benefits through Reduction of Vessel Speed at Sea</a></p>
Policy research, such as, continue to evaluate effectiveness of voluntary and incentive based seasonal slow speed zones and shift in SB Channel TSS, and future implemented management measures	<p>McKenna et al 2012: Voluntary speed reductions have been largely ineffective in southern California. Vessel Speed Reduction Incentive Trial Report</p> <p>Vessel Speed Reduction Incentive Trial Report 2015: Incentivized vessel speed reduction works, but need funding and resources to scale up from a pilot project</p> <p>Review of tools that have been employed internationally to reduce ship strike risk: 1) Abramson et al. 2009 includes four case studies from the United States 2) Silber et al. 2012 reviews IMO actions to reduce vessel threat to whales</p>	Need to conduct lit review of what has happened internationally in the last 5 years		Need to review what has been used internationally to reduce ship strike risk. How effective how these measures been?	<p><a href="#">2012 McKenna et al: Response of commercial ships to a voluntary speed reduction measure - Are voluntary strategies adequate for mitigating ship strike risk?</a></p> <p><a href="#">2015 Birney et al - Protecting Blue Whales and Blue Skies - Report on the 2014 VSR Incentive Trial in the SBG</a></p> <p><a href="#">2012 Silber et al: The role of the International Maritime Organization in reducing vessel threat to whales: Process, options, action and effectiveness</a></p> <p><a href="#">2009 Abramson et al: Reducing the Threat of Ship Strikes on Large Cetaceans in the Santa Barbara Channel Region and Channel Islands National Marine Sanctuary: Recommendations and Case Studies</a></p> <p><a href="#">2008 Silber et al: Report of a workshop to identify and assess technologies to reduce ship strikes to large whales</a></p>
Identify and assess emerging technologies to enhance whale detection and whale avoidance	Silber et al 2008: The problem of ship strikes is a complex one with no easy technological fixes. Technologies applicable to reducing ship strikes are limited almost entirely to those that enhance whale detection. However, detection and relating information about a whale's location representing only part of the equation: the mariner must possess capabilities (e.g. adequate communication systems, adequate response time) to take evasive action to a detected whale. All technologies assessed had certain advantages and disadvantages when considered relative to this problem. See full report for more information.	Studies are needed to confirm that any technology developed and used for this purpose are clearly capable of reducing strikes and to ensure that added environmental impacts are not introduced.		Need to determine efficacy of onboard thermal imagery to detect whales ahead of ships	
Explore expansion of whale sighting data collection efforts with vessels of opportunity e.g. shipping industry, NPS, USCG, CDFW, oil industry service vessels, research vessels	NOAA Fisheries, working with Cascadia Research Collective, has conducted 6 ride-alongs on commercial vessels to assess the viability of commercial ships as sighting platforms and the ability to engage crews in reporting sightings. Preliminary data indicates that these vessels are valuable observation platforms. Full write up expected December 2015.				
Ship/whale interactions and ship strike risk	There are many publications that look at ship strike risk, the fatality of ship strikes, and the impacts of various management measures on reducing the risk of ship strikes. See reference library.			<a href="#">See folder of Ship Strike Literature</a>	
Improve monitoring efforts to track whale distribution spatially and temporally throughout the region, especially south of the Channel Islands	NOAA SWFSC conducted 7 Marine Mammal Survey cruises from 1995 to 2008			More data should be collected throughout the region in a systematic way.	
<b>** Check out the full MSWG reference library here:</b> <a href="https://drive.google.com/open?id=0B_48nD8n3IcVcVVOF9ns5mNqTEk">https://drive.google.com/open?id=0B_48nD8n3IcVcVVOF9ns5mNqTEk</a> Updated 9/30/15					



















